

On the Identity of *Spongiocladia* and *Cladophoropsis*¹

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IN THEIR TREATMENTS of the green algae in Engler and Prantl's "Die Natürlichen Pflanzenfamilien," Wille (1911: 119) and Printz (1927: 282) consider *Spongiocladia* Areschoug (1853) as a genus of questionable merit. This belief was founded upon the observation of Weber-van Bosse (1890) that examples of *Struvea delicatula* which lived in association with the sponge *Halichondria* bore a great resemblance to *Spongiocladia vaucheriaeformis*, the type species of the genus *Spongiocladia*.

However, in a later work, Weber-van Bosse (1913: 86) not only maintained *Spongiocladia* but emphasized that she had not demonstrated that *S. vaucheriaeformis* actually was a form of *Struvea delicatula* living in association with a sponge, and that there consequently was no justification for the statement of Wille (*loc. cit.*): "Nachdem es von A. Weber v. Bosse nachgewiesen worden ist, dass die typische Art: *S. vaucheriaeformis* Aresch. nur eine durch Symbiose mit einer Spongie (*Halichondria*) umgebildete *Struvea*-Art darstelle, muss auch die Stellung der 2 übrigen Arten: *Spongiocladia dichotoma* (Zanard.) Murr. et Boodle, sowie *S. neocaledonica* Grun. als sehr zweifelhaft angesehen werden."

Even though there probably is no particularly close relationship between *Spongiocladia* and *Struvea* Sonder (1845), both of which belong to the order Siphonocladales, but to the families Siphonocladaceae and Boodleaceae, respectively, I have on a number of oc-

casions been struck by the agreement in the published descriptions and illustrations of *Spongiocladia* and *Cladophoropsis* Børgesen (1905), both members of the family Siphonocladaceae. The purpose of the present article is to assemble the published facts and to record my own observations in support of the contention that these two genera of essentially tropical and subtropical marine algae actually are identical, a conclusion which Børgesen (1948) has also reached. Finally, *Cladophoropsis*, which is the better known genus, is proposed for conservation against *Spongiocladia*.

The genus *Spongiocladia* was erected by J. E. Areschoug in 1853 upon a new species, *S. vaucheriaeformis*, which he received from Mauritius. The plants grew upon encrusting corallines, forming a horizontal spongiöse mass, from which issued erect, more or less dichotomously divided, spongiöse growths. Both the horizontal and the erect portions of the thallus were composed of irregularly branched, septate, uniseriate filaments and, as shown in Areschoug's figure 3, the branches of the filaments lacked a cross wall at the base. Reproduction appeared to be by swarmers, many of which germinated within the cells in which they were produced. The thallus contained an abundance of sponge spicules, especially at the terminal ends of the erect portions.

Thirty years later the known geographic distribution of *Spongiocladia vaucheriaeformis* was extended to Singapore by Hauck (1884). His study of the plant led him to the significant conclusion that systematically it belonged in the immediate vicinity of *Siphonocladus*, a genus which had been founded a few years previously by Schmitz (1879) to

¹This study was made during the tenure of a Guggenheim Fellowship.

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accommodate two species, one of which was subsequently removed to *Cladophoropsis* by Børgesen (1905).

In 1888 Murray and Boodle published an account of the genus *Spongocladia* based upon a study of material of *S. vaucheriaeformis* from Mauritius and New Guinea and of two additional species from the south Pacific. They pointed out for the first time that the genus *Spongodendron* of Zanardini (1878), which was based upon two species (*S. crassum* Zanard. and *S. dichotomum* Zanard.) from New Guinea, was indistinguishable from *Spongocladia*. *Spongodendron crassum* was found to be identical with *Spongocladia vaucheriaeformis* whereas *Spongodendron dichotomum* could be maintained as a distinct species under the binomial *Spongocladia dichotoma* (Zanard.) Murray et Boodle. In addition, Murray and Boodle gave a brief account and the formal diagnosis of a new species from New Caledonia, *Spongocladia neocaledonica* Grunow, which differed from the others in having a compact thallus.

Up to the present no additional species of *Spongocladia* appear to have been described, but our knowledge of the genus has been enlarged in certain respects and the known geographical range of two of the species has been extended.

Heydrich (1894) reported *S. vaucheriaeformis* and *S. dichotoma* from the Ryukyu Islands, south of Japan. He was the first to bring attention to the fact that the thalli were not composed of a single plant but of a large number of individual *Cladophora*-like plants. In agreement with the observations of Zanardini and Murray and Boodle, he found that the filaments composing the thallus produced attachment organs, or tenaculæ, by means of which they anastomosed with near-by filaments, forming a kind of network.

Heydrich was also the first to give an account of the method of formation of the so-called aplanospores (or coniocysts, as they had been called by Zanardini). He regarded

Spongocladia as essentially a unicellular alga, which, like *Valonia*, formed aplanospores which produced daughter individuals that remained attached to the mother-plant. As we now know, the aplanospores of Heydrich were protoplasmic masses formed in consequence of segregative division, a characteristic feature of the order Siphonocladales. Like Hauck, Heydrich placed *Spongocladia* near *Siphonocladus*.

In 1913 Weber-van Bosse recorded *S. vaucheriaeformis* from Makassar and neighboring islands in the Dutch East Indies. She expressed the opinion that *Spongocladia* probably represented special forms of algae known otherwise by different names.

Okamura in 1916 recorded the occurrence of *S. vaucheriaeformis* at Ponape and Saipan in the Caroline and Marianas Islands, respectively. In a later work (1928), he confirmed the observation of Areschoug regarding the germination of spores (?) within the cells in which they were formed. He also saw and figured stages in their germination on the outside of filaments of the thallus. The germination of spores (?) within the reproductive structures was later observed by Yamada (1934) also. He appears to have been the first to have noted pores in the walls of the fertile cells, which suggests that the spores (?) are motile and that those which had been seen within the cells had merely failed to escape, as is so often true in the algae.

Although Okamura (1928) does not seem to have been fully aware of it, he clearly observed (see pl. 250, fig. 11) septation of the filaments by segregative division, thus confirming the observation (in the light of present knowledge) of Heydrich.

As far as I am aware, Dickie (1875), Jadin (1934), Lucas (1935), and Børgesen (1940, 1946, as well as 1948) are the only authors in addition to those already mentioned who have studied *Spongocladia*. Dickie, Jadin, and Børgesen included *S. vaucheriaeformis* in their lists of algae from Mauritius, whence

the species was first described, and Lucas reported it from Lord Howe Island.

In summary, then, a synthesis of the accumulated knowledge concerning the general morphology of *Spongiocladia* reveals the following features as most characteristic of the genus:

1. The thallus is in the form of a prostrate, spongioid growth, which remains as a compact mass in *S. neocaledonica* or produces erect, branched, *Codium*-like processes in *S. vaucheriaeformis* and *S. dichotoma*.

2. The thallus is composed of intertwining, branched, septate filaments, with the cells arranged in a single series.

3. The branches of the filaments are not separated by a cross wall at the point of juncture with the parent filament.

4. Septation of the filaments is by segregative division.

5. The filaments form attachment organs, or tenaculæ, by means of which they anastomose with other filaments, forming a kind of network.

6. Reproduction is by swarmers which are produced in the unmodified cells of the filaments.

These characters, with the possible exception of the first one listed above, indicate that *Spongiocladia* Areschoug (1853) is identical with *Cladophoropsis*, a genus which was segregated from *Siphonocladus* Schmitz (1879) by Børjesen in 1905. This conclusion is supported by my own observations (particularly in regard to the absence of a cross wall at the point of attachment of the branches to the parent filaments) upon a species of *Spongiocladia* (seemingly *S. vaucheriaeformis*) from the Philippine Islands and by those of Børjesen (1946, 1948) upon *S. vaucheriaeformis* from Mauritius. The agreement in the general appearance of the filaments composing the thallus in *Spongiocladia* and *Cladophoropsis* is shown in Figure 1a and b, respectively, which are reproductions of illustrations by Børjesen from material gathered

in the type regions of the type species of the two genera.

The observations of Børjesen in this connection are especially significant inasmuch as they were made, not only upon topotype material of the type species of *Spongiocladia*, but by the author of *Cladophoropsis*. In 1946 (p. 17) he remarked: "According to my observations of the alga [*S. vaucheriaeformis*] it seems to me very like *Cladophoropsis*, for instance, *Cl. Zollingeri* . . ." and in 1948 (p. 24) he said, "the alga, being the biont of the sponge, is quite like that found in the formerly examined specimens, and thus in my opinion is a *Cladophoropsis*."

Seemingly, the only difference between *Spongiocladia* and *Cladophoropsis* lies in the general habit of the two genera. In *Cladophoropsis* the thalli are in the form of cushions, turfs, or tufts whereas in two of the species of *Spongiocladia* (*S. vaucheriaeformis* and *S. dichotoma*) the basal prostrate system ordinarily produces erect, *Codium*-like portions. However, these differences are not constant and appear to be of a specific rather than a generic nature. Support for this contention is furnished by two facts: (1) In *S. neocaledonica* the thallus is in the form of a compact, barely branched growth, somewhat comparable to that of *Cladophoropsis membranacea* (Børjesen, 1913: 43 and 47) and certain other species in which the thallus is in the form of dense cushions or turfs. (2) Even in *S. vaucheriaeformis* the thallus may at times, according to Børjesen (1948: 23), be in the form of an extensive prostrate mat, with the erect portions reduced to conical growths of only 2-3 cm. in height.

Since the time that Børjesen (1905) erected *Cladophoropsis*, and transferred to it seven species which had previously been placed in *Siphonocladus*, the genus has been found to be well represented in tropical and subtropical waters, and to contain a few species which are known only from temperate regions. A search through the literature re-

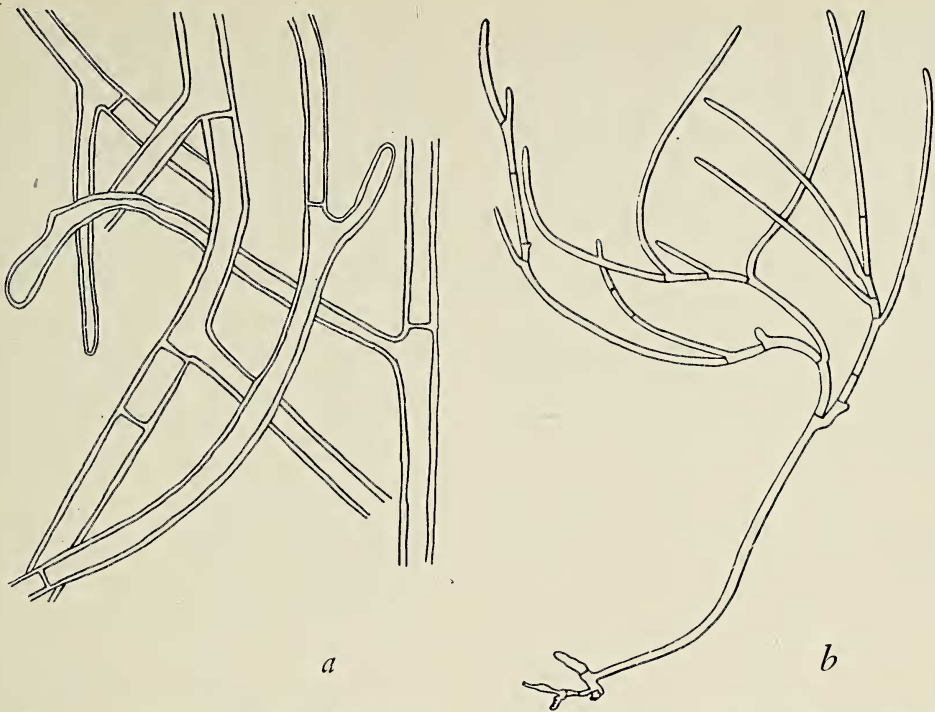


FIG. 1. *a*, *Spongocladia vaucheriaeformis*: filaments from the upper part of the thallus of a plant from Mauritius. $\times 45$. *b*, *Cladophoropsis membranacea*: a part of the cushion-like thallus of a plant from the Virgin Islands. About $\times 5$. (From Børgesen, 1948 and 1905, respectively.)

veals that up to the present some 19 species have been accredited to *Cladophoropsis*. They are: *C. brachyartra* (Sved.) Børgesen (1905); *C. fallax* Schiffner (1933); *C. fasciculata* (Kjellm.) Børgesen (1905); *C. gracillima* Dawson (1950); *C. herpestica* (Mont.) Howe (1914), incl. *C. coriacea* Yendo (cf. Yamada, 1944); *C. howensis* Lucas (1935); *C. infestans* Setchell (1924); *C. limicola* Setchell (1924); *C. macromeres* Taylor (1928); *C. membranacea* (Ag.) Børgesen (1905); *C. modonensis* (Kütz.) Børgesen (1905); *C. pallida* Beardseth (1941); *C. peruviana* Howe (1914); *C. psyttaliensis* (Schm.) Børgesen (1905); *C. rigida* (Howe) Feldmann (1938); *C. robusta* Setchell et Gardner (1924); *C. sundanensis* Reinbold (1905); *C. voluticola* (Harriot) Børgesen (1905); and *C. Zollingeri* (Kütz.) Børgesen (1905).

Considering the wide recognition which *Cladophoropsis* has received in the course of

the past 45 years as contrasted with *Spongocladia*, which has been referred to in a comparatively small number of publications, it would be advantageous to reject the latter name in favor of the former, and it is accordingly proposed that *Cladophoropsis* be considered for conservation.

CLADOPHOROPSIS Børgesen (Siphonocladaceae), K. Danske Vidensk. Selsk. Forhandl. 1905: 288, 1905.

versus

Spongocladia J. E. Areschoug, Öfvers. K. Vetensk.-Akad. Förhandl. 10: 202, 1853.

Type species: *Cladophoropsis membranacea* (Ag.) Børgesen.

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